Otolith morphometric analysis to discriminate populations of the New Zealand whitebait species *Galaxias maculatus* (inanga)

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Background

- *Galaxias maculatus* is amphidromous (Figure 1)
- Juvenile "whitebait" form the basis of an iconic fishery
- Juvenile population dynamics are poorly understood
- Populations are managed as homogenous entities

Figure 1. Amphidromous lifecycle of *G. maculatus*

Otolith morphometrics

- Otolith shape = genetics & environment
- Used as a population discrimination tool (sprat, herring)
- Geometric approach, two methods

1. Shape indices (ratio of otolith dimensions)
2. Elliptical Fourier coefficients (EFcs) (describes outline trajectory)

Aims

1. Examine otolith shape variability between two populations of *G. maculatus* juveniles
2. Examine its potential to elucidate population structure

Hypotheses

H_0: Oceanographic currents limit the exchange of juveniles between Bay of Plenty and Buller populations (Figure 2)

H_0: Otolith shape is different between populations

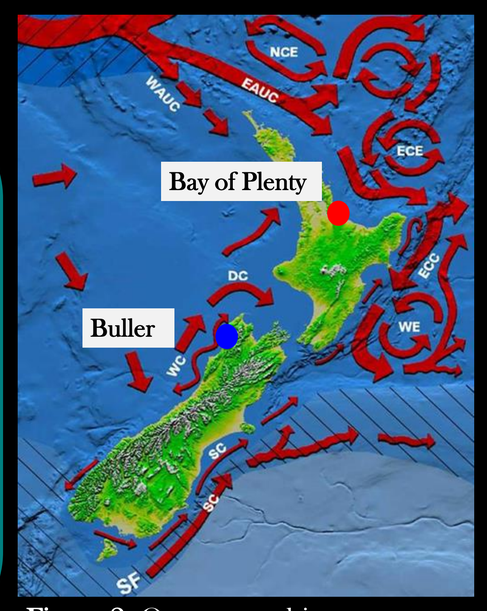


Figure 2. Oceanographic currents

Methods

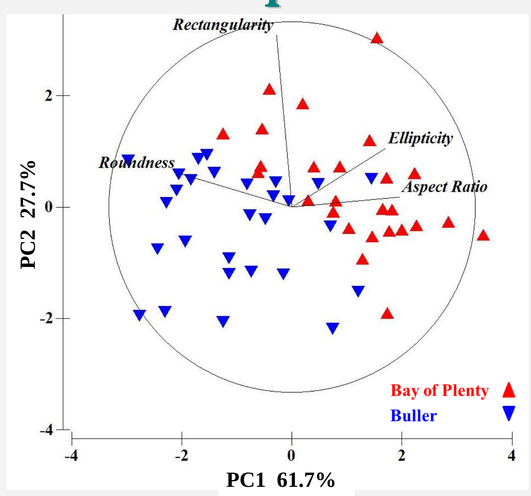
- Juvenile "whitebait" collected September 2013 from Buller and Bay of Plenty (Figure 2)
- 45-55mm TL fish used in analysis (n=52)
- Left sagitta photographed
- Sagitta measured, shape indices calculated (Table 1)
- 10 EF harmonics generated in SHAPE v1.3
- Principal component analysis (PCA) used to summarise variability in shape indices
- EFcs used to construct average otolith shape for both regions (Figure 3)

Size parameters	Size based shape indices
Area (A)	Roundness (Rnd) = $(4A)/(\pi r OL^2)$
Perimeter (P)	Rectangularity (Rec) = A/(OL x OW)
Otolith Length (OL)	Aspect ratio (Ar) = OL/OW
Otolith Width (OW)	Ellipticity (Ell) = (OL-OW)/(OL+OW)

Table 1. Shape indices used in analysis

Results

PCA shape indices



Outline reconstruction

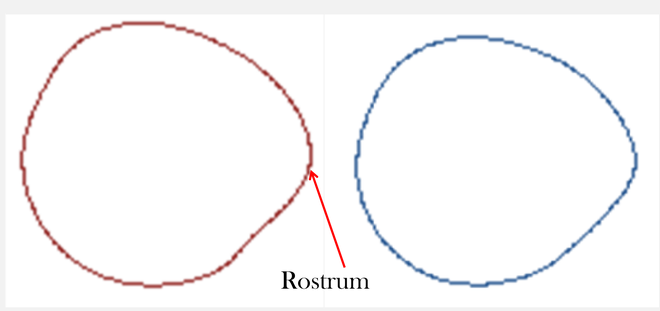


Figure 3. Average outline reconstruction using EFcs for Bay of Plenty and Buller populations

Summary

- Regional grouping of shape indices evident (PERMANOVA p=<.001)
- Outline reconstruction of EFcs illustrates slightly more pronounced rostrum in Bay of Plenty populations

Conclusion

- Otolith shape analysis suggests these populations are distinct
- Shape differences may reflect genetic or environmental history (temperature, feeding, growth rates)
- Otolith shape is potentially a valuable tool for population discrimination
- Populations from Canterbury and Golden Bay will also be analysed

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